

Agricultural Research Institute, Pusa

Description of a New Species of Tapeworm
Dipylidium catus, n. sp.

with

A Note on the Genus *Dipylidium* Leuckart
1863

BY

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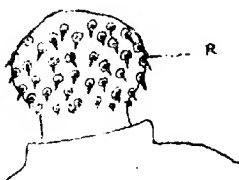
Description of a New Species of Tapeworm,
Dipylidium catus, n. sp.
with
A Note on the Genus *Dipylidium* Leuckart,
1863.

(Received for publication on the 9th October 1928.)

I. Description of *Dipylidium catus* n. sp.

A pure bred Siamese cat (the property of Mr. Hearsey, Farm Manager, Muktesar), born and brought up in Almora (Kumaon), United Provinces, India, and suffering from suspected tuberculosis, was submitted to *post-mortem* examination on 10th June, 1925, at this Institute, but no lesion of this disease could be detected. The writer was given the opportunity to examine the intestines of the animal for parasitic helminths, when over 500 specimens of a tiny species of tapeworm, and a single Ascarid specimen, were collected. The following description of the former parasite was worked out.

The worm measures 28 to 40 mm. in length consisting of 30 to 40 proglottids. The head is globular and distinctly marked off from the rest of the body. There is a small unsegmented neck which is only slightly narrower than the head. The worm gradually broadens pos-



Camera lucida drawing of rostellum and hooks $\times 200$.

teriorly; the segments, which are broader than long to begin with, gradually increase in length and become longer than broad in mature and gravid segments, when they measure 3 to 4 mm. \times 0.6 to 1.5 mm. Measurements of other parts are:—

Head. 0.35 to 0.44 mm. broad, and 0.35 to 0.6 mm. long (including extended rostellum but not neck); when the rostellum is withdrawn, the head measures 0.27 to 0.42 mm. long.

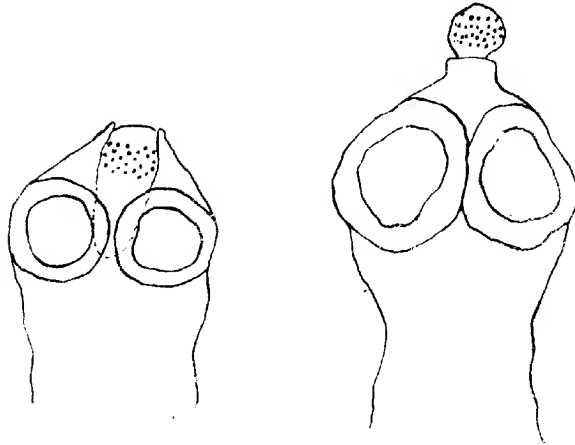
Rostellum. 0.08 mm. to 0.12 mm. long, and 0.08 mm. broad (in the widest portion).

Anterior segment. 0.04 mm. long and 0.35 mm. broad.

Mature segments. 1.5 to 2.5 mm. long and 0.35 to 0.6 mm. broad.

Gravid segments. 3 to 4 mm. long and 0.6 to 1.5 mm. broad.

The suckers are rounded and are provided with circular cup-like excavations, but they assume an elliptical form in contracted specimens. The rostellum is short, and in an extended condition roughly resembles



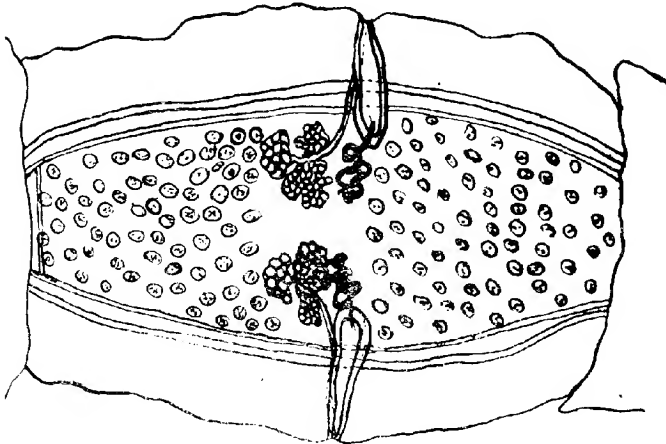
Camera lucida drawing of head
showing withdrawn rostellum \times 60.

Camera lucida drawing of head showing
extended rostellum \times 60.

the knob of a handle but in its retracted condition it may sometimes present the general appearance of a blunt cone. The knobbed or globular portion is covered with five to six alternating rows of hooks, which

are typically shaped like rose thorns. The size of the hook gradually decreases from front backwards, the largest measured being 12 microns and the smallest 6 microns. The total number of hooks varies from 50 to 60.

Each segment has a pair of longitudinal excretory canals on each side. The genital pores, located anterior to the middle or sometimes in the middle of the lateral margin in mature segment, and always anterior to the middle in the unripe segments, are not prominent. The testes in mature segments are 120 to 150 in number lying always between



Camera lucida drawing of a mature segment showing internal morphology $\times 40$.

the excretory canals anterior and posterior to the rest of the genitalia. The vas deferens is coiled and runs posteriorly and centrally. The cirrus pouch is much elongated, is deflected towards the anterior, and extends one-third to one-half of its length across the longitudinal excretory canals and measures 0.25 to 0.3 mm. in length. The ovaries are in two lobes, one on each side of the oviduct and the inner lobe is larger than the other lobe, each of these lobes being composed of distinct lobules. The vitellarium is slightly smaller than the ovary and is composed of distinct lobules which present the appearance of a bunch of grapes. The eggs lie in groups of 2 to 13 in each egg-capsule. The

egg-capsules are not densely packed in gravid segments and do not extend beyond the longitudinal excretory canals.

As the species described in this paper differs in certain essential characters from the species of *Dipylidium* hitherto recorded, the writer proposes for it the name *Dipylidium catus*.

Definition of Dipylidium catus. Length 28 to 40 mm. and maximum width 1.5 mm. Rostellum bears 5 to 6 rows of rose-thorn-shaped hooks, and is conical or knobbed. Genital pore anterior to the middle or middle of the lateral margin of segments. Testes 120 to 150 in number. Ovaries slightly larger than the vitellarium. Cirrus pouch extends one-third to one-half of its length across the excretory vessels. Egg-capsules contain 2 to 13 eggs. Habitat: duodenum of Siamese cat (*Felis domestica*). Locality: Muktesar, U. P. India.

II. A Note on Speciation in the Genus *Dipylidium* Leuckart, 1863.

A comparative study of more important morphological characters, that have been used by previous writers for the erection of new species in the genus *Dipylidium*, has been made by the writer in their application to five species of *Dipylidium*, namely:—*D. caninum*, *D. oerleyi*, *D. sezecoronatum*, *D. walkeri* and *D. catus*. In the case of the genus *Strongyloides*, specificity of the host has been regarded by Sandground (1925) as the best indication of the specific identity of a parasite, and a cross infection test, the most reliable means to confirm the diagnosis. This would however appear to fail in the case of the genus *Dipylidium*, where a single species is known to occur in more than one species of host, such as one finds in the case of *D. caninum* which occurs in dog, cat and man, whilst two or more species may be harboured by the same species of host, as is illustrated in the case of *D. caninum*, *D. sezecoronatum*, and *D. walkeri*, all of which occur in the dog. In the case of digenetic cestodes, a study of their life-histories may provide a basis for specific determination, but the labour involved in following the developmental processes undergone by digenetic tapeworms in their invertebrate hosts is likely to be enormous, and observations are likely to be prolonged over a great length of time for the determination of intermediate hosts alone. Concluding from the observations of the writer on five species in his collection, namely, *D. caninum*, *D. oerleyi*, *D. sezecoronatum*, *D. walkeri*, and *D. catus*, an attempt is made below to adjudge the relative value of such characters as have been hitherto employed for diagnostic purposes. These characters are the total length, numbers of rows of hooks, length of cirrus sac, distribution of egg-capsules and the number of eggs in each capsule, number and distribution of testes, shape of vitellarium and position of genital pore.



Diagrammatic sketch of the entire tapeworm $\times 19$.

(A) TOTAL LENGTH.

The greatest length recorded for *Dipylidium* would appear to have been in the case of a *D. caninum*, namely, 40 cm. ranging from a minimum length of 15 cm., but complete specimens collected at Muktesar never measured more than 20 cm., nor less than 10 cm. The size of worms is subject to variation on account of age, damage, the medium employed for fixation and preservation, and the conditions under which they develop in their normal habitat. *D. walkeri*, *D. sexcronatum*, and *D. oerleyi* measure 10 to 28, 10 to 23.5, and 5 to 11 cm., respectively. The first two species are thus very near each other in length, whilst the maximum length of *D. oerleyi* places it near either of the other two species. It, however, offers itself as a dependable character for marking off relatively small species like *D. catus* and *D. buencaminoi* (which do not exceed 4 mm. in length), from the other four species referred to above.

(B) NUMBER OF ROWS OF HOOKS.

In the case of the genera *Tania* and *Multiceps*, *t* is the number of hooks that has been regarded as of importance in specific diagnosis, whereas in the case of the genus *Dipylidium*, workers have largely relied upon the number of circlets and rows of hooks—perhaps on account of the fact that this has been considered simpler than the counting of individual hooks. Experience has shown, however, that the disposition of the alternate rows of hooks in individual specimens is liable to considerable variation on account of (1) Loss of some hooks in the process of detachment from the host; (2) some hooks having been shed owing to the parasites being kept too long in salt solution, before fixation, or the host having died long before the collection of the specimens; (3) contraction of rostellum in longitudinal direction and the consequent shortening of the initial distance between consecutive rows of hooks or its contraction in the transverse direction, bringing two alternate rows in closer proximity and sometimes practically in one line. In view of such errors as would be liable to occur on account of the last two possibilities, the total number of hooks would appear to be a better guide in diagnostic work than the number of rows.

(C) LENGTH OF CIRRHUS SAC.

The fact whether this organ extends up to or across the excretory canals has been regarded as an indication of the specific position of an individual, but in the course of the study of the five species mentioned above, slight variations in this respect have been observed in different segments of the same individual or in different individuals of the same

pecies, such misleading variations being probably brought about as a result of contraction in strong fixatives or extension or lengthening of the worms on keeping them too long in saline (as a first step towards degeneration). The actual length of the cirrus sac itself has appeared to the writer to constitute a better character in specific diagnosis.

(D) DISTRIBUTION OF EGG-CAPSULES AND THE NUMBER OF EGGS IN A CAPSULE.

The distribution of egg-capsules depends upon the relative egg-producing power of the individual segment. The egg-capsules in gravid segments extend beyond the excretory canal in *D. caninum*, *D. oerleyi*, and *D. sexocoronatum*, but are limited by the canals in *D. walkeri* and *D. catus*. It is interesting to note in this connection that in the case of two specimens of *D. caninum* the egg-capsules in the cortical portion, lying beyond the excretory canals, had been passed before those in the medullary portion, as was evidenced by the fact that the last gravid segment of the strobilus in some of these specimens had no egg-capsules in the cortical portion but had some in the medullary portion, while the penultimate segment was found packed tightly upto its very boundary wall.

The number of eggs in egg-capsules has been found to vary considerably by various workers, the variation observed being perhaps due to the fact that counts have always been made while the egg-capsules were inside the gravid segment, and so represented all stages from their early development to complete maturity. In the case of *D. catus*, an examination of the intestinal contents of the host showed that all the 15 specimens of egg-capsules encountered had a constant number of 13 eggs in them. The maximum number counted from transverse sections was also found to be 13. The eggs in a gravid segment varied from 14 to 20 microns in diameter.

(E) NUMBER AND DISTRIBUTION OF TESTES.

The large variation in the number of testes described by various authors for different species was also observed in the five species referred to above, the number of the testes increasing gradually from front backwards as far as the segments in which the egg-capsules begin to make their appearance. The distribution, however, may not be constant, as changes originating from contraction and spread of the uterine sac may drive the testes beyond the excretory canals, as has been noticed in the case of *D. walkeri*.

(F) SHAPE OF VITELLARIUM.

This character is subject to considerable variation, such as has been described for various species ("irregular," "reniform," "like a bunch of grapes," "composed of minute follicles," etc.). A similar variation has been observed in different segments of the same individual in all the five species studied. An irregular appearance was noticed in transitional segments between mature and gravid segments. Vitellaria of the shape of bunch of grapes were seen in mature segments, and in the case of *D. catus* the bunches appeared as composed of minute follicles, under the effect of fixative (formalin 5 per cent.). Reniform appearance was seen in immature segments.

(G) POSITION OF THE GENITAL PORE.

This character shows the least amount of variability and appears to be fairly constant in mature and gravid segments although slight individual irregularities may on rare occasions be seen in some segments.

III. Systematic consideration of the Genus *Dipylidium* Leuckart, 1863.

Beddard, in 1913, distinguished from the genus *Dipylidium* a new genus *Diplopylidium* on the basis of the female genital pore being located anterior to that of the cirrus sac or the male pore, and *Dipylidium zschokkei* (Hungerbuhler, 1910) is now included under Beddard's genus *Diplopylidium*. Skrjabin (1924) defined another new genus *Progygopylidium*, the head of which is armed with 3 to 4 rows of hooks; those of the first row are equipped with a handle (manubrium) and there is a basal discoidal portion, i.e., *Tania*-like hooks; the female opening is situated either anterior or ventral to, never behind, that of the cirrus sac; and the egg-capsules contain one egg each. In addition to the type species *P. nolleri*, the author regarded *D. trinchesei* from cat and *D. avicola* from birds as also members of this new genus. Lopez-Neyra,

In a recent publication, Lopez-Neyra (1927) lays stress on the following five characters in the systematic consideration of the genus *Dipylidium* :—

- (1) Reticulate uterus which may be (a) replaced by thick-walled capsules containing many eggs, (b) replaced by thin-walled capsules which ultimately break into single-egged capsules, or (c) replaced by simple reticular ranges which ultimately break into single-egged capsules;
- (2) crotchets, (a) *Tenia*-like, or (b) rose-thorn shaped;
- (3) testes which may be (a) not more than 90, or (b) more than 90;
- (4) vagina, (a) posterior to cirrus pouch, or (b) ventral or anterior to cirrus pouch;
- (5) strobilus, (a) short slender, sexual pores in the anterior $\frac{1}{3}$ of the segment, or (b) long and broad, sexual pores in the neighbourhood of the middle of lateral border of the segment.

however, thinks that the genus *Progygnopylidium* is indistinguishable from *Diplopylidium* which also has a row of *Tania*-like hooks. He creates another genus, *Joyeuxia* distinguishable from *Diplopylidium* by the anterior position of the genital pore, the testicles being less than 90 in number, and egg-capsules containing one egg only in ripe segments. The following is a key to the genera of the sub-family *Dipylinae* Stiles, 1896 :—

Hooks: All rose-thorn-shaped Vagina situated posterior to the male opening.	<div style="display: inline-block; vertical-align: middle; font-size: 3em; line-height: 1;">{</div> <div style="display: inline-block; vertical-align: middle;"> 1. Genital pore situated in the middle or behind the middle of the lateral border of a segment; eggs upto 20 in each capsule <i>Dipylidium</i>. 2. Genital pore situated distinctly anterior to the middle of lateral border of a segment; one egg in each capsule </div>
Hooks: Anterior row <i>Tania</i> -like .	<div style="display: inline-block; vertical-align: middle; font-size: 3em; line-height: 1;">{</div> <div style="display: inline-block; vertical-align: middle;"> <i>Joyeuxia</i>. Vagina situated ventrally or anterior to the opening of cirrus; one egg in each capsule <i>Diplopylidium</i>. </div>

A list of the species belonging to these three genera is given below.

List of the species of Genus Dipylidium (sensu stricto) Lopez-Neyra, 1927 (Leuckart), 1863.

No.	Species	Length of specimens in mm.	No. of testes in males	Size of testes in mm.	No. of eggs per capsule	Size of eggs in microns	Hosts	Distribution
1	<i>D. caecum</i> (Linnaeus, 1758)	150—400	3—4	12—18	3—20	43—50	<i>Homo sapiens</i> ; <i>Canis familiaris</i> ; <i>C. aureus</i> ; <i>C. mesopictus</i> ; <i>Meleagris gallopavo</i> ; <i>Perdix perdix</i> ; <i>Capra hircus</i> ; <i>Felis catus domesticus</i> ; <i>Felis catus domesticus</i> ; <i>Felis concolor</i>	Cosmopolitan.
2	<i>D. aduncum</i> V. Balz, 1909	50—110	5	13—17	3—12	15	<i>F. catus domesticus</i> ; <i>Canis familiaris</i>	Hungary; Spain; East Africa; India.
3	<i>D. aduncum</i> V. Balz, 1909	100—200	6	11—14	2—15	25	<i>F. catus domesticus</i> ; <i>Canis familiaris</i>	Hungary; U. S. A.; India.
4	<i>D. aduncum</i> Sodhi, 1923	100—150	6—7	12—2	1—15	25	<i>Canis familiaris</i>	Punjab (India).
5	<i>D. asiaticum</i> Serebrenn., 1923	168	12—15	15—12	3—12	30 by 17	<i>Canis familiaris</i> ; <i>Felis catus domesticus</i>	Russia.
6	<i>D. bollii</i> T. Blanchard, 1927	..	8	12—10	5—7	25	<i>Felis catus domesticus</i>	Philippine Islands.
7	<i>D. grandis</i> Milnes, 1926	..	5—6	8—5	3—10	30	<i>Canis familiaris</i> ; <i>Felis catus domesticus</i>	California.
8	<i>D. campodori</i> Milnes, 1926	..	6	15—9	2—10	36	<i>Felis catus domesticus</i>	Do.
9	<i>D. delphinus</i> Milnes, 1926	..	6—8	9—5	3—10	33	<i>F. catus domesticus</i>	Do.
10	<i>D. lanudum</i> Milnes, 1926	..	5	7—5	6—15	40	<i>F. catus domesticus</i>	Do.
11	<i>D. cuniculi</i> Milnes, 1926	..	5—7	19—4	6—15	53	<i>Canis familiaris</i>	Do.
12	<i>D. catus</i> Loew	2—4	5—6	12—6	2—13	14—20	<i>Felis catus domesticus</i> (Siamese cat)	Malabar, India.
13	<i>D. lanudum</i> T. Blanchard, 1927	30	4	7	3—12	..	<i>Canis familiaris</i>	Philippine Islands.

List of the species of Genus *Joyeuxia* Lopez-Neyra, 1927.

No.	Species	Length of the scolex in mm.	No. of hooks	Size of hooks in microns	No. of testes	No. of eggs in a capsule	Size of eggs in microns	Host	Distribution
1	<i>J. chyeri</i> (Diamare, 1892)	120—200	12—14	14—5	45—50	1	52—38	<i>Felis catus domestica</i>	Hungary, Spain, Algeria, East Africa.
2	<i>J. paquierei</i> (Diamare, 1892)	20—30	16	7—8	50—65	1	64—87	<i>Felis catus domestica</i> ; <i>Canis familiaris</i>	Egypt and Spain.
3	<i>J. echinorhynchoides</i> (Sonsino, 1889)	25	16—25	16—5	50	1	..	<i>Megadontia verda</i> ; <i>Fulpes dipper</i> ; <i>Felis catus domestica</i> .	North Africa.
4	<i>J. pennieri</i> (Setti, 1892)	10—40	16	19	60—70	1	..	<i>Oryzopsis tigrina</i> ; <i>O. oryza</i> ; <i>Epidendrum riverina</i> ; <i>Paradoxurus hermaphroditicus</i> .	North Africa and India.
5	<i>J. fulvumanti</i> (Ewer, 1924)	30	14—16	?	40—50	1	..	<i>Zitragaturus ernei</i> ; <i>Felis catus</i> .	South Africa.

NOTE: *J. sp.* (Kolani, 1917) is regarded by Ewer (1924) as identical with *J. fulvumanti*. Kolani recorded this species from *Felis capensis philippi*.

List of the species of Genus Diplopygidium (Beddard, 1913), Lopez-Neyra, 1927.

No.	Species	Length of strobilus in mm.	No. of rows of hooks	Size of hooks in microns	No. of testes	No. of eggs per capsule	Size of capsule in microns	Hosts	Distribution
1	<i>D. trindleri</i> (Damas, 1932)	23	4	47—60 and 36	25—32	1	40—52	<i>Felis catus dom.</i>	Europe.
2	<i>D. triseriale</i> (Lüh, 1896)	23	3	63—89 and 38—43	?	1	..	<i>Viverra zibetha</i> ; <i>Genetta afr.</i>	Tunis; India.
3	<i>D. monophorum</i> (Lüh, 1896)	10	3	80—3 and 20	..	1	..	<i>Viverra zibetha</i> ; <i>Genetta afr.</i>	Tunis; Algeria.
4	<i>D. catus niger</i> (Führmann, 1908)	..	4	45—38	..	1	30	<i>Columba</i> sp.
5	<i>D. zachvatkini</i> (Hungerbühler, 1940)	120	3	40—17	30	1	30—40	<i>Cynictis penicillata</i>	South Africa.
6	<i>D. eucaucasicolum</i> (Lopez-Neyra and Ximor, 1921)	32—65	5	68—71 and 13	46—68	1	38—34	<i>Felis catus dom.</i>	Spain.
7	<i>D. genetta</i> (Beddard, 1913)	..	2	?	Many testes.	1	..	<i>Genetta douglasae</i>
8	<i>D. nalleri</i> (Skrjabin, 1924)	..	3—4	53—45 and 10	12—16	1	?	<i>Felis catus dom.</i>

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